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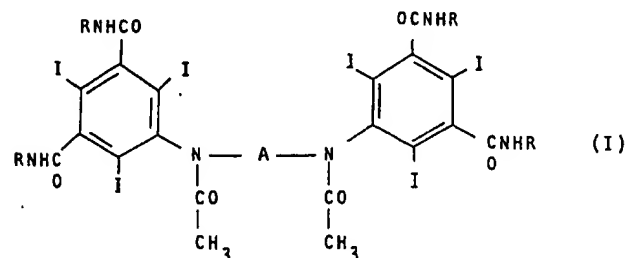
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54 X-ray contrast agents.

57 Compounds of the general formula:-



(where R is a group $-\text{CH}(\text{CH}_2\text{OH})_2$ or $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$ and A is a group $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2-$ or $-\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_2-$) possess a package of favourable parameters which render them of particular use not only in all forms of intravascular visualisation but also in myelography.

The compounds are prepared by reaction of an appropriate 5-acetylamino-N,N'-bis(hydroxypropyl)-2,4,6-triodoisophthalamide with an agent effective to introduce the appropriate hydroxyalkylene group such as for example epichlorohydrin or 1,4-dichloro-2,3-dihydroxybutane.

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X-RAY CONTRAST AGENTS

The present invention relates to novel non-ionic X-ray contrast agents, to compositions containing them and to methods for their manufacture.

5 In our British Patent Specification No. 1,321,591 we describe and claim certain non-ionic compounds as X-ray contrast agents, such compounds representing an important advance over previously known ionic
10 X-ray contrast agents in respect of side effects due to high concentrations of ions and/or to high osmolality. Such compounds are suitable for one or more possible fields of X-ray visualisation but are not usually suitable for a wide range or spectrum of such uses. In general, non-ionic X-
15 ray contrast agents may be of use in two main fields, namely:-

Intravascular visualisation, including urography and angiography, for example cerebral, coronary and peripheral angiography, and

20 Myelography, i.e. injection into the cerebrospinal fluid.

Radiologists have used different X-ray contrast agents particularly adapted to different fields of use but there are clearly advantages if it is
25 possible to use a single X-ray contrast agent for a wide range of uses; apart from economies of scale in manufacture, it is also more satisfactory for the radiologist to be able to use experience of a contrast agent gained in one field of use, e.g.
30 urography, in some other field, e.g. angiography or myelography. For the purposes of this specification an X-ray contrast agent which can be used in all forms of intravascular visualisation and myelography is termed a 'general X-ray contrast agent'.

- 2 -

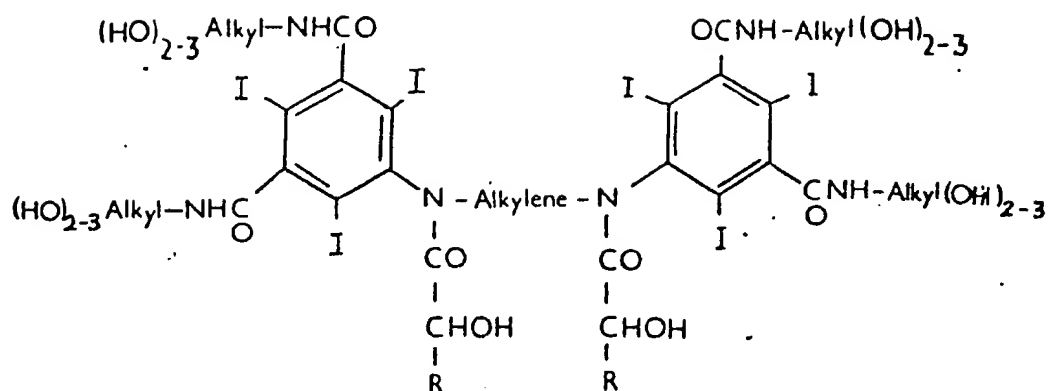
A general X-ray contrast agent should possess a 'package' of favourable parameters, namely low toxicity, low osmolality, low viscosity, low nephro-toxicity, high urinary excretion and, in particular,
5 the ability to produce solutions of high concentration but low osmolality.

It is known that X-ray contrast agents which possess close structural similarities may nevertheless possess very different properties such as for example
10 toxicity. Thus it is a difficult empirical task to identify a compound which possesses a complete package of favourable parameters and which can be used as a general X-ray contrast agent.

As indicated above, one of the principal
15 advantages of non-ionic X-ray contrast agents is their low osmolality as compared with ionic compounds, due to the reduction in the number of dissolved particles present at a particular iodine concentration. Low osmolality is desirable in order to reduce
20 tissue damage arising from unduly high osmotic pressures generated by the very high concentrations at which X-ray contrast agents are administered. The osmolality can be reduced still further if the number of iodine atoms in each non-ionic molecule
25 can be increased and it has been proposed to use relatively large molecules containing two triiodo-phenyl rings joined by a short chain. However, such large molecules commonly exhibit nephrotoxicity and are thus thought to be unsuitable for vascular
30 X-ray visualisation.

In particular, European Patent Application 0023992A1 of Bracco Industria Chimica S.p.A. describes non-ionic X-ray contrast agents of the general formula

- 3 -



where (HO)₂₋₃ Alkyl represents a 1,3-dihydroxyisopropyl, 2,3-dihydroxypropyl or 1,3-dihydroxy-2-hydroxymethylisopropyl group, R represents hydrogen or methyl and

- 5 Alkylene represents a divalent alkylene group with 2 to 10 carbon atoms, which can be substituted by hydroxy functions, or a mono-, di- or poly-oxa-alkylene group with 4 to 12 carbon atoms, which can be substituted by hydroxy functions. These
- 10 compounds are indicated only for visualisation of the subarachnoid space, where the question of nephrotoxicity is not particularly relevant. Although the Alkylene group is permitted to carry hydroxy functions, the only compounds for which any results
- 15 are given do not have hydroxy functions on the group Alkylene. Indeed in our hands the Bracco synthesis as applied to the preparation of such compounds having hydroxy alkylene chains, invariably produced rearranged derivatives.

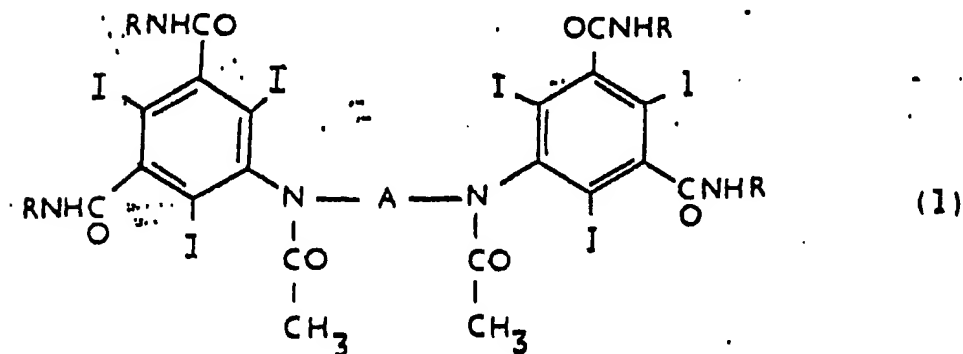
- 20 It should be noted that the Bracco compounds all carry a relatively large number of hydroxyl groups including one in each of the acyl (lactyl) functions. This would be expected to lead to relatively high viscosities and it would normally be thought desirable
- 25 to avoid additional hydroxyl functions, for example, on the Alkylene group, in the absence of other compensating factors. Furthermore, it is well

- 4 -

known that a hydroxyl group on an N-alkyl grouping of a triiodoaniline often undergoes nucleophilic reaction at high temperatures at the adjacent C-I bond with cyclisation. The Bracco patent suggests protection of such OH groups but this would clearly complicate any synthesis and would lead a chemist to choose the simpler solution of avoiding hydroxyl groups in Alkylene.

We have now found that a small group of non-ionic X-ray contrast agents of the same general type as those of European Patent Application 0023992A1 but possessing acetyl groups in place of the two lactyl groups and having a hydroxylated alkylene chain joining the two triiodoaniline rings, have outstanding properties, including low nephrotoxicity, which enable them to be used for vascular as well as for subarachnoid visualisation, that is as general X-ray contrast agents.

According to the present invention, therefore, we provide compounds of the general formula I



(where R is a group $-\text{CH}(\text{CH}_2\text{OH})_2$ or $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$ and A is a group $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2-$ or $-\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_2-$) including the stereoisomeric forms thereof separately or in combination.

Formula I includes four compounds, namely
Compound A; R = $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$; A = $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2-$

- 5 -

Compound B; $R = -CH(CH_2OH)_2$; $A = -CH_2CH(OH)CH_2-$
Compound C; $R = -CH_2CH(OH)CH_2OH$; $A = -CH_2CH(OH)CH(OH)CH_2-$
Compound D; $R = -CH(CH_2OH)_2$; $A = -CH_2CH(OH)CH(OH)CH_2-$

- 5 These compounds may exist in several isomers due to chiral carbon atoms. In addition, the compounds exhibit exo/endo isomerism due to restricted rotation of the N-CO bond in the acetamido groups caused by the proximity of the bulky iodine atoms.
- 10 The invention extends to all the isomeric forms of the compounds, including optically active, racemic and meso isomers.

- As indicated above, the compounds of the invention exhibit a package of outstanding properties
- 15 rendering them capable of use in all forms of X-ray visualisation. The compounds possess osmolalities significantly lower, for example more than 50% lower, than comparable compounds having a single triiodinated benzene ring. Thus, the osmolality
- 20 of Compound A is 196 mOs/Kg H_2O at 300mgI/ml and 223 mOs/Kg H_2O at 350 mgI/ml. The osmolality of Compound B is 120 mOs/Kg H_2O at 195 mgI/ml and 160 mOs/Kg H_2O at 295 mgI/ml. The osmolality of Compound C is 242 mOs/Kg H_2O at 370 mgI/ml. The
- 25 osmolality of Compound D is 189 mOs/Kg H_2O at 300 mgI/ml and 224 mOs/Kg H_2O at 350 mgI/ml. It will be noted from the above values that the compounds are capable of forming solutions of very high concentration.

- The nephrotoxicity levels of the compounds
- 30 are acceptably low, compared to many known 'bis' X-ray contrast agents. The nephrotoxicity of Compound A in rabbits is 7.5 gI/Kg, that of Compound B is also 7.5 gI/Kg and that of Compound C is 10.5gI/Kg. The intravenous toxicities of the compounds in
- 35 mice are also low, that of Compound A being 14.4 gI/Kg, that of Compound B and Compound C being 18.5gI/Kg.

- 6 -

The viscosities of the compounds at high concentrations are acceptable, given their high molecular weights and content of hydroxyl groups. Thus, the specific viscosity of Compound A at 300 mgI/ml is 18.9 cP at 20°C and 8.7 cP at 37°C, while at 350 mgI/ml it is 44.5cP at 20°C and 17.7 cP at 37°C. The viscosity of Compound B at 300 mgI/ml is 18.4cP at 20°C and 8.7cP at 37°C, while at 370 mgI/ml it is 62 cP at 20°C and 23.6 cP at 37°C. The viscosity of Compound C at 300 mgI/ml is 22.7cPat 20°C and 10.3cP at 37°C, while at 350 mgI/ml it is 54.7cP at 20°C and 21.7cP at 37°C.

The urinary excretion levels of the compounds of the invention in rabbits are higher than those expected for the X-ray contrast agents presently in clinical use. Such agents are generally excreted in the range 50 - 150 mg I/ml urine when the compound is given at a dose of 500 mgI/kg body weight. In comparison, compounds of the present invention when given at a dose of only 200 mg I/kg are excreted as listed below. The figures are median values and the figures in brackets are the number of animals investigated.

	Compound A	218 mg I/ml	(9)
25	Compound B	218 mg I/ml	(7)
	Compound C	230 mg I/ml	(10)
	Compound D	191 mg I/ml	(9)

The subarachnoid tolerances of the compounds A and C in unanaesthetised rabbits were particularly good being generally at least as good as that of N,N-bis (2,3-dihydroxypropyl)-5-[N-(2,3-dihydroxypropyl)-acetamido]-2,4,6-triiodoisophthalamide. In anaesthetised rats no motoric or convulsive effects were observed on administration of Compounds A and C to 7 out of 8 rats.

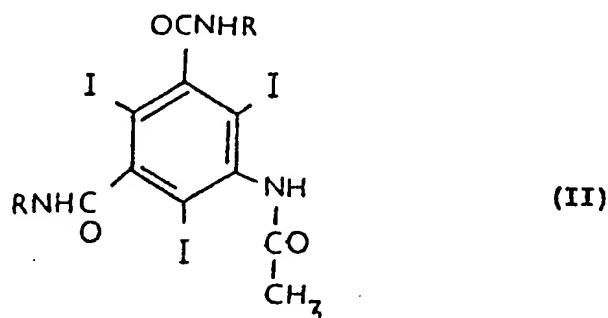
The present invention also provides radiological compositions comprising as active ingredient at least one of the compounds of formula I as hereinbefore defined in association with a radiological carrier.

- 7 -

The radiological compositions of the present invention are conveniently presented in a form suitable for administration by injection, for example, in ampoules or vials. The capacity of the ampoule or vial may be, for example, from 5 to 500 ml and the concentration may, for example, be from 20 to 500 mg I/ml.

The compounds of the present invention may be prepared in any convenient manner, but the following process is of particular interest and constitutes a further feature of the present invention.

Thus there is provided a process for the preparation of the compounds of formula I as hereinbefore defined which comprises reacting the compound of formula:



(where R has the above meaning) or a hydroxyl protected derivative thereof with a compound of the formula III X-A-X' (where X and X' are readily eliminatable atoms or groups and A has the above meaning) or a hydroxyl protected derivative thereof or a corresponding epoxide in which one or both of the substituents X and X' and the hydroxyl group on an adjacent carbon atom are replaced by -O- followed, where required, by removal of any unwanted protecting groups. Thus, the groups X and X' compounds of Formula III may be chosen from halogen atoms, e.g.

chlorine, bromine or iodine, or sulphate or hydrocarbyl-sulphonyloxy groups, e.g. alkyl- or aryl-sulphonyloxy groups such as tosyloxy or mesyloxy. The compound of Formula III may thus be epichlorohydrin or 1,4-dichloro-2,3-dihydroxybutane.

As indicated above, the hydroxyl groups present in the groups R and A may, if desired, be in a hydroxyl protected form; suitable protecting groups include acyl groups such as acetyl or, where adjacent hydroxyl groups are concerned, cyclic ketal or acetal groups.

The reaction between compounds II and III is preferably effected in the presence of an acid binding agent, for example an organic or inorganic base preferably in an aqueous or alcoholic medium such as water or an alkanol or glycol; an alkali metal alkoxide such as sodium methoxide or an alkali metal hydroxide such as sodium or potassium hydroxide may be used as base.

Any protecting groups may be removed by standard methods, for example hydrolysis. The compound of formula II may be prepared by acetylation of the corresponding compound having a free amino group and in such a reaction, hydroxyl groups in the substituents R may also be acetylated. Such acetyl groups may be removed by basic hydrolysis.

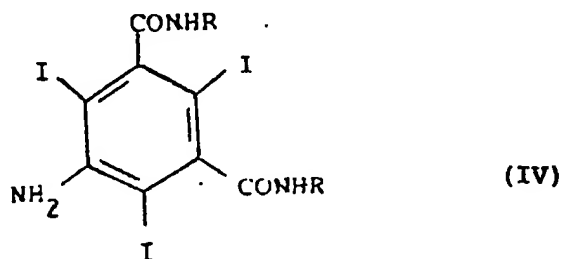
If necessary, the product may be purified by preparative chromatography.

The compounds of formula II may be prepared in any convenient manner, for example, by reaction of 5-acetamido-2,4,6-triiodoisophthaloyl chloride and/or 5-diacetylamino-2,4,6-triiodoisophthaloyl chloride with 1,3-dihydroxy-2-propylamine or 2,3-dihydroxypropylamine followed, where the 5-diacetylamino compound is used, by removal of one N-acetyl group, e.g. by alkaline hydrolysis at slightly elevated temperature. The reaction may, for example, be effected in the presence of dimethylformamide or

- 9 -

dioxan as solvent, conveniently in the additional presence of an alkali metal or alkaline earth metal carbonate or bicarbonate such as potassium bicarbonate.

A compound of formula II may also be prepared
5 for example, by acetylation of a compound of the formula:



(where R has the above meanings).

Acetylation may be effected by any convenient method
10 e.g. by the use of acetic anhydride (which can also serve as the solvent) together with catalytic amounts of a mineral acid e.g. sulphuric or perchloric acid, or by the use of an acid halide preferably in a polar solvent such as dimethylformamide or
15 dimethylacetamide. Where unwanted O-acetyl groupings are formed these may be removed either at this stage or after the reaction with the compound of formula III. The basic hydrolysis of the O-acetyl grouping may for example, be effected using aqueous
20 alkali metal hydroxide, e.g. sodium hydroxide, the reaction preferably being carried out at slightly elevated temperature, e.g. about 50°C.

In addition, depending on the acylating agent used, other products may be formed and require
25 separation. When an acyl anhydride such as acetic anhydride is used with concentrated sulphuric acid as catalyst, the primary amino group is often, in part, bis-acetylated, such that an overacetylated

- 10 -

product is obtained. In general a mixture of acetylated products will be obtained. If desired, the bis-acetylamino group may be hydrolysed to the monoacetylamino group under mild basic conditions e.g. by the use
5 of sodium hydroxide in, for example, methanol prior to N-hydroxyalkylation. It is, however, possible to effect N-hydroxyalkylation using the bis-acetylamino compound with simultaneous solvolysis.

The following examples are given by way of
10 illustration only: all temperatures are in °C:-

Example 1

1,4-Bis(acetylamino)-N,N'-bis[3,5-bis(2,3-dihydroxypropyl-
15 aminocarbonyl)-2,4,6-triiodophenyl]-2,3-dihydroxybutane
(Compound C)

5-Acetylamino-N,N'-bis(2,3-dihydroxypropyl)-
2,4,6-triiodoisophthalamide (75 g, 100.4 mmol)
was dissolved in methanol (230 ml) containing sodium
20 hydroxide (6.03 g, 150 mmol) at room temperature. To this solution 1,4-dichloro-2,3-dihydroxy-butane,
dissolved in methanol (25 ml), was added and the
resulting mixture was stirred at room temperature
for 42 hours. The above described 1,4-dichloro-
25 2,3-dihydroxybutane was prepared as follows; 1,2,3,4-
diepoxybutane (4.89 g, 56.9 mmol) was dissolved
in water (70 ml) and concentrated hydrochloric
acid (9.5 ml) was slowly added while the reaction-
mixture was cooled in ice-water. After stirring
30 for 30 min. the reaction-mixture was concentrated,
and redissolved in methanol (25 ml).

The reaction was quenched by adding concentrated
aqueous hydrochloric acid (pH 2). Filtration and
evaporation gave the crude reaction product (85.0
35 g). This material was purified using preparative
LC (Waters LC 500, prepPak C-18). Eluent: 14%
methanol in water. 8 runs of 8.5 g. The product
was eluted between 3.0 l and 4.5 l, and the total

- 11 -

eluent was about 9 l. The purest fractions were collected and evaporated to dryness at 60°C in vacuo.

Yield: 24 g, melting point 228-233°C.

5 HPLC: RP-18. 5 μ m, gradient 5-17% acetonitrile.

3 peaks. 18,47 min (4.6%). 19,20 min (61.5%).

20,85 min (33.5%). These three peaks correspond to endo/endo, exo/exo and exo/endo (endo/exo).

The product gave three spots on TLC (precoated

10 TLC plates. Silica gel 60 F-254 from Merck AG)

Eluent: n-BuOH: H₂O: HOAc. (50: 25: 11), R_f 0.19, 0.18 and 0.15.

Found C: 27.64, H: 2.94, I: 48.3 Calc. for

C₃₆H₄₆I₆N₆O₁₆ C: 27.36, H: 2.93, I: 48.2.

15

Example 2

1,3-Bis(acetylamino)-N,N'-bis[3,5-bis(1,3-dihydroxy-2-propylaminocarbonyl)-2,4,6-triiodophenyl]-2-hydroxy-propane (Compound B)

20 5-Acetylamino-N,N'-bis(1,3-dihydroxy-2-propyl)-2,4,6-triiodoisophthalamide (400g, 0.535 mol) was slurried in water (1600 ml) at room temperature. Sodium hydroxide (16.1g, 0.040 mol) was added followed by epichlorohydrin (37.2g, 0.40 mol). After about

25 3 days the starting material was completely dissolved. HPLC (Column: Brownlee Labs, RP 18 Spheri 5 5 μ m, 4.6 mm i.d. x 25 cm. Linear gradient: 1-20% CH₃CN in water, 0.2% per min, flow: 1 ml per min. Detector: UV 254 nm) of the reaction mixture showed

30 about 60% of the "dimer" compound, about 23% of the "monomer" compound and about 2% of the starting material. The rest of the peaks represented unidentified compounds. The solution was neutralized with hydrochloric acid and evaporated to dryness at 60° in

35 vacuo. The product was dissolved in a mixture of 17% methanol in water to a final volume of 600ml and purified by preparative liquid chromatography (Instrument: Prep LC/System 500 (Waters Ass)).

- 12 -

Column: PrepPak-500/C₁₈. Eluent: 17% methanol in water. Flow: about 200ml/min). The purification was performed by injecting a portion (15ml) of the solution mentioned above. The "monomeric" compound was eluted first and was readily separated from the desired product which followed. Other impurities were eluted from the column after the desired product. When a sufficient volume of the eluent had been passed through the column to remove the most strongly retained components, the procedure was repeated with a new portion of the crude product. The purest fractions of the product were eluted between 1.5-4.5 l and total volume of eluent used for one injection was about 8 l. The corresponding fractions were collected and evaporated to dryness at 50-60° in vacuo.

The purest fractions were purified once more by preparative LC. This time the column was loaded with 5g substance (10ml solution) and eluted with 14% methanol in water. The product was eluted between 2.4-5.0 l, and the total eluent was about 8 l. The purest fractions were collected and evaporated to dryness at 50-60° in vacuo. Yield: 70g, Melting point: 305-310° decomp. HPLC (the same conditions as described above) show two peaks with retention times 39.97 and 44.04 minutes.

Probably these two peaks represented the endo/exo and exo/exo isomers. The product gave three spots by TLC (precoated TLC Plates Silica Gel 60 F-254 gtp, Merck A.G. and developed in n-BuOH: HOAc:H₂O= 50:11:25) with R_f values 0.24, 0.28 and 0.31 in the ratio 2-3:30-35:60-70, respectively. Probably the spots represented the endo/endo and exo/exo isomers in order of increasing R_f values. (Found: C 27.14; H 2.94; I 48.5; N 5.40; O 15.18. Calc. for C₃₅H₄₄I₆N₆O₁₅: C 27.12; H 2.87; I 49.12; N 5.42; O 15.48).

- 13 -

The starting material 5-acetylamino-N,N'-bis(1,3-dihydroxy-2-propyl)-2,4,6-triiodoisophthalamide was prepared as follows:

- 5-Amino-N,N'-bis(1,3-dihydroxy-2-propyl)-
5 2,4,6-triiodoisophthalamide (300g) was suspended
in acetic anhydride (1.5l) at 90° (on the oil bath)
and then p-toluenesulphonic acid (3g) was added.
The mixture was heated for 4½ hours and then cooled
slowly to room temperature. The product was collected
10 on a filter and washed with small amounts of acetic
anhydride. Yield: 353g. The product was suspended
in a mixture of methanol (600 ml) and water (300ml)
at room temperature and then pH was adjusted to
about 11.5 by adding 5N sodium hydroxide (200 ml).
15 This mixture was heated at 50°C and more 5N sodium
hydroxide (235ml) was added dropwise in such a
manner that pH was kept at about 10.5. After 2-3
hours pH did not decrease, and the hydrolysis was
finished. After cooling to room temperature the
20 mixture was acidified with 6N hydrochloric acid
to pH 6.2. After stirring for two hours at room
temperature, the mixture was cooled to 3° for 2-3
days. The product was collected on a filter, suspended
in water (500ml) and filtered again. Yield: 257g.
25 Melting point: above 270°. (Found: C 25.68; H
2.85; I 51.0; N 6.03. Calc. for $C_{16}H_{20}I_3N_3O_7$:
C 25.72; H 2.70; I 50.96; N 5.62) TLC (precoated
TLC Plates Silica Gel 60 F-254 from Merck A.G.
and developed in $CHCl_3$:MeOH=70:30) showed one spot
30 with R_f value 0.38.

Example 3

1,3-Bis(acetylamino)-N,N'-bis[3,5-bis(2,3-dihydroxypropyl-
aminocarbonyl)-2,4,6-triiodophenyl]-2-hydroxypropane.

35 (Compound A)

5-Acetylamino-N,N'-bis(2,3-dihydroxypropyl)-
2,4,6-triiodoisophthalamide (200g, 0.268 mol) was
slurried in water (800ml) at room temperature.

- 14 -

Sodium hydroxide (8.0g, 0.20 mol) was added and epichlorohydrin (18.6g, 0.20 mol) was added. After three days the starting material was dissolved and the solution neutralized with diluted hydrochloric acid. The solution was evaporated to dryness at 50° in vacuo finally purified by preparative LC in a similar manner as described in Example 1. Yield: 37g. Melting point: 240 - 250°. TLC (Precoated TLC Plates Silica Gel 60 F-254 from Merck A.G. and developed in n-BuOH :HOAc: H₂O=50:11:25) showed two spots with R_f values 0.26 and 0.28 which probably represented the endo/exo and the exo/exo isomers, respectively. The ratio between the two spots was about 1:2 in order of increasing R_f values. HPLC (the same conditions as described in example 1) showed two peaks with retention times 48.39 and 52.30 minutes, respectively. (Found: C 27.40; H 3.03; I 48.4; N 5.37; O 15.31. Calc. for C₃₅H₄₄I₆O₁₅: C 27.12; H 2.86; I 49.12; N 5.42; O 15.48)

Example 4

1,4-Bis(acetylamino)-N,N'-bis[3,5-bis(1,3-dihydroxy-2-propylaminocarbonyl)-2,4,6-triiodophenyl]-2,3-dihydroxybutane. (Compound D)

5-Acetylamino-N,N'-bis(1,3-dihydroxy-2-propyl)-2,4,6-triiodoisophthalamide (224g, 0.3 mol) was slurried in water (900ml). Sodium hydroxide (6ml 5M) was added and then 1,2,3,4,-diepoxybutane (19.4g, 0.225 mol) was added. After three days TLC (Precoated TLC Plates Silica Gel 60 F-254 from Merck A.G. and developed in n-butanol: acetic acid: water= 50:11:25) of the reaction solution showed three new spots with R_f values 0.25, 0.26 and 0.29 representing the three endo/exo isomers of the desired product. The ratio of the spots were about 2-3: 30-35: 60-65 in order of increasing R_f values. The reaction mixture was neutralized and then treated with strongly acid cation exchange resin (Amberlite IR 120) and

- 15 -

strongly basic anion exchange resin (Dowex 1x4) to remove inorganic salts. After filtration the solution was evaporated to dryness at 50° in vacuo. Yield: 240g. The product was dissolved in methanol (1500ml) and precipitated by adding isopropyl alcohol (1500ml). Yield: 160g. Further purification was performed by preparative LC in a similar manner as described in example 1. The eluent was 15% methanol in water. Yield: 101g. Melting point: 310-317° (Found: I 47.5 Calc. for $C_{36}H_{46}I_6O_{16}$: I 48.18).

Radiological compositions

1,4-Bis(acetylamino)-N,N'-bis[3,5-bis(2,3-dihydroxypropylaminocarbonyl)-2,4,6-triiodophenyl]-2,3-dihydroxybutane (Compound C) of the present invention, trometamol (TRIS) and the edetate ($CaNa_2$ EDTA) are dissolved in water suitable for injection (approximately 500 ml). The pH is adjusted to 7.5 by means of hydrochloric acid (5M), and sodium chloride is added to make the solution isotonic. Water suitable for injection is added to make the volume of the solution up to 1000 ml. The solution is membrane-filtered and dispensed into bottles or injection vials.

The infusion solutions are prepared in bottles of 250 ml and 500 ml, while solutions for injection are dispensed in 20, 50 and 100 ml injection vials.

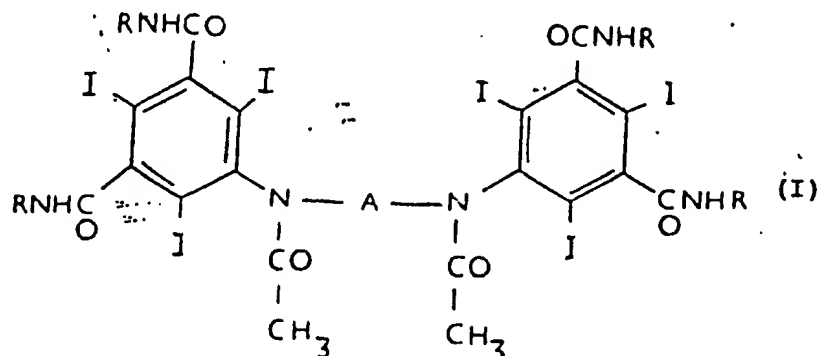
The dispensed products are autoclaved for 20 min at 120°C.

- 16 -

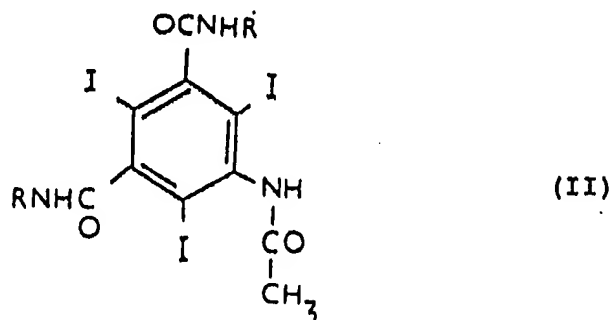
Example	A	B	C	D	E	F
Composition 1 litre	100 mg I/ml Infusion	150 mg I/ml Infusion	180 mg I/ml Infusion	240 mg I/ml Infusion	350 mg I/ml Infusion	440 mg I/ml Infusion
Compound C	207.5 g	311.5 g	373.4 g	497.9 g	726.1 g	912.9 g
Trometamol (TRIS)	1.2 g	1.2 g	1.2 g	1.2 g	1.2 g	1.2 g
Sodium/ calcium edetate (CaNa ₂ EDTA)	0.1 g	0.1 g	0.1 g	0.1 g	0.1 g	0.1 g
Sodium chloride ad isotonic						
Water for injection ad 1000 ml						
HCl 5M to make pH 7.5						

Claims

1. Compounds of the general formula:-



- (where R is a group $-\text{CH}(\text{CH}_2\text{OH})_2$ or $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$
 5 and A is a group $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2-$ or $-\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_2-$ including the stereoisomeric forms thereof separately or in combination.
2. 1,4-Bis(acetylamino)-N,N'-bis[3,5-bis(2,3-dihydroxypropylaminocarbonyl)-2,4,6-triodophenyl]-
 10 2,3-dihydroxybutane.
3. 1,3-Bis(acetylamino)-N,N'-bis[3,5-bis(1,3-dihydroxy-2-propylaminocarbonyl)-2,4,6-triodophenyl]-2-hydroxypropane.
4. 1,3-Bis(acetylamino)-N,N'-bis[3,5-bis(2,3-dihydroxypropylaminocarbonyl)-2,4,6-triodophenyl]-
 15 2-hydroxypropane.
5. 1,4-Bis(acetylamino)-N,N'-bis[3,5-bis(1,3-dihydroxy-2-propylaminocarbonyl)-2,4,6-triodophenyl]-2,3-dihydroxybutane.
- 20 6. A process for the preparation of compounds of formula I as defined in claim 1 which comprises reacting a compound of the formula:



- 18 -

- (where R is as defined in claim 1) or a hydroxyl protected derivative thereof with a compound of the formula III X-A-X' (where X and X' are readily eliminatable atoms or groups and A is as defined
- 5 in claim 1) or a hydroxyl protected derivative thereof or a corresponding epoxide in which one or both of the substituents X and X' and the hydroxyl group on an adjacent carbon atom are replaced by -O- followed, where required, by removal of any
- 10 unwanted protecting groups.
7. A process as claimed in claim 6 wherein the compound of formula III used is epichlorohydrin or 1,4-dichloro-2,3-dihydroxybutane.
8. Radiological compositions comprising as active
- 15 ingredient a compound of formula I as defined in claim 1 in association with an inert carrier.
9. Compositions as claimed in claim 8 in vials or ampoules.
10. Compositions as claimed in claim 9 wherein
- 20 each vial or ampoule contains the said active ingredient in a concentration of from 20 to 500 mgI/ml.

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EUROPEAN SEARCH REPORT

Application number

EP 83 30 6766

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
Y	US-A-3 804 892 (B.G.A. INGELMAN) * Claims; column 3 *	1,6,8-10	C 07 C 103/78 A 61 K 49/04
Y	FR-A-2 354 316 (NYEGAARD) * Claims *	1,8-10	
Y	EP-A-0 049 745 (SCHERING) * Claims *	1,8-10	
D,Y	EP-A-0 023 992 (BRACCO) * Claims *	1,6-10	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
			C 07 C 103/00 A 61 K 49/00
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 07-02-1984	Examiner MOREAU J.M.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			